Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37	ET Docket No. 14-165

Reply of Nominet to Petition for Rulemaking by the Microsoft Corporation

Summary

This is Nominet's response to Microsoft's Petition for Rulemaking to the Federal Communications Commission (FCC).

Nominet broadly supports the position Microsoft has set out in its Petition, and agrees these are practicable recommendations that will support the further utilisation of white spaces devices (WSDs) while continuing to provide robust protection to licensed users. This objective is also in line with the Commission's strategic objectives to enhance connectivity, and to ensure the efficient use of radio spectrum.

Nominet's views are set out in detail in the response below.

1. *Higher radiated power limits in less congested areas*: Nominet supports recommendations for higher power limits in less congested areas, but also asks how this definition might be drawn to better target those rural and remote areas of greatest interest to the Commission.

2. *Higher-power operation in first-adjacent channels*: Nominet supports the Petition's proposals on adjacent channels, citing examples of comparable methods successfully used in other TVWS jurisdictions, and commenting from practical experience on the technical difficulties of operating white space databases (WSDBs).

3. *Fixed WSDs at High Above Average Terrain < 500m*: Nominet does not believe the proposed coordination process is necessary in the context of the automated process the FCC operates for unlicensed spectrum. Nominet proposes additional detail to the process in the event that it is deemed necessary.

4. *TVWS for Narrowband IoT*: Nominet welcomes the Petition's recommendation to treat Narrowband WSDs as a distinct class of device in regulation, and sets out where additional detail is required.

5. *Fixed WSD on Movable Platforms*: Nominet supports the Petition's proposals, but urges greater clarity in the rules, and makes additional proposals to help facilitate operation of WSD in transit.

Nominet welcomes the opportunity to respond with specific comments on this Petition, and would welcome future opportunities to collaborate with the Commission and with Microsoft on rulemaking.

Nominet

Nominet is driven by a commitment to use technology to improve connectivity, security and inclusivity online.

For 20 years, Nominet has run the .UK internet infrastructure, developing an expertise in the Domain Name System (DNS) that now underpins sophisticated network analytics used by governments and enterprises to mitigate cyber threats. Nominet continues to explore applications for a range of emerging technologies including autonomous vehicles and new tools to support spectrum management, designed to respond to the rapid expansion of demand on spectrum.

Nominet's continued support for the TV White Spaces initiative in the United States has been a key component of this. Any proposal to bolster TVWS adoption is closely aligned with the FCC's commitment to ensuring the quality, choice and reach of wireless connectivity.

1. Higher radiated power limits in less congested areas

Nominet supports the Petition's recommendations on higher power limits in less congested areas, and believes these are proportionate in furthering the reach of TVWS networks without risk of harmful interference.

Microsoft's proposal correctly states that, while unlikely, if a white spaces device (WSD) causes an interference event then identification of the culprit device is "straightforward". White space database (WSDB) administrators are required to publish fixed WSD registrations,[1] including their location, and to provide to the Commission any other information (e.g. active Personal/Portable devices) upon request.[2]

Microsoft's proposal for higher power limits relies on the existing definition of 'less congested areas'.[3] Nominet notes several implications of this definition:

Given that the required separation distances from the protected contours of TV Stations are specified in terms of the WSD's height above average terrain (HAAT),[4] the number of channels available to a WSD depends on its HAAT, and therefore its height above ground level (HAGL). Whether its location is less-congested depends on the number of channels available, and therefore also on the HAGL of the device. Given also that the 'congestedness' of a location is evaluated separately in the low VHF, high VHF, and UHF TV bands, it is more precise to state e.g. "the UHF TV band is less congested for WSDs with HAGL [Symbol] 20m" at a particular location. This definition is unduly complex, and it is computationally expensive to produce maps of congestedness to facilitate the planning of TVWS networks.

[1] CFR 47, Chapter I, Subchapter A, Part 15, §15.715(m)
[2] Ibid. §15.713(k)
[3] Ibid., §15.703(h)
[4] Ibid., §15.712(a)

Changes to protected entities (e.g. TV Stations) routinely cause changes in channel availability for WSDs. If a WSD is sited in a less-congested area where almost half the channels are unavailable in e.g. the UHF band, then a single change in channel availability means that more than half the channels are unavailable and the location ceases to be less congested. A WSD sited at that location below 30m AGL will have its maximum transmit power in available channels reduced from 40dBm to 36dBm; this may be inconvenient but tolerable. However, following the March 2019 R&O, Fixed WSD are permitted to transmit at HAGL up to 100m in less-congested areas. If this area ceased to be less congested as described,
then any WSD sited above 30m is required immediately to cease transmission without prior notice. The risk of such events is likely to preclude any deployment of TVWS above 30m AGL in such areas.

The Commission should reconsider its definition of 'less congested area' in favour of a less complex definition which is not susceptible to
immediate unforeseeable changes with disproportionately abrupt effects on WSDs. Nominet favours a definition based on the population density of the particular census block/block group/tract/county the WSD is sited within, or within a given separation of.

2. Higher-power operation in first-adjacent channels

Background

Nominet observes that terrain-based TV protection is successfully used in the TVWS frameworks of other jurisdictions, and that no events of harmful interference have yet been reported.

In the United Kingdom, Ofcom's TVWS model uses terrain-based point-to-point simulation for the purposes of co-channel and adjacent-channel protection of Digital Terrestrial Television (DTT).[5] Using technical data describing the TV transmitters – some of which is not in the public domain – and simulating propagation & coverage with the proprietary UK Planning Model, Ofcom pre-generate WSD power limits for 5 different device classes, each at 7 different heights AGL, in 100m pixels across the entire UK. This large 'DTT Protection Dataset' is provided to WSDBs, who combine it with rules to protect other entities (e.g. wireless microphones) in order to provide available channels and power limits to WSDs on request. Nominet has commercially operated a WSDB under this framework in the UK since January 2016.

The foundation of the FCC model is preventing harmful WSD emissions to a TV user who may be located anywhere within a TV station's protected contour, with all locations in the contour treated equally. The foundation of the Ofcom model is preventing harmful WSD emissions to TV users located in each of many 100m pixels, with power limits to protect each pixel calculated individually, and using a high-resolution population dataset to protect only those pixels which contain occupied households.

The Dynamic Spectrum Alliance (DSA) publish Model Rules for TV White Spaces[6] as a template framework for countries to implement TVWS without needing to develop one from scratch, anticipating each country customizing the model as appropriate.

The DSA model also uses terrain-based point-to-point simulation for the purposes of co-channel and adjacent-channel protection of Television. The algorithm for protecting TV is derived from the Ofcom framework, using the non-proprietary Longley-Rice point-to-point model for

[5] Ofcom. *Implementing TV White Spaces*, 2015. https://www.ofcom.org.uk/__data/assets/pdf_file/0034/68668/tvws-statement.pdf

[6] Dynamic Spectrum Alliance, Model Rules and Regulations for use of TVWS, 2018. http://dynamicspectrumalliance.org/wp-content/uploads/2018/01/Model-Rules-and-Regulations-for-the-use-of-TVWS.pdf

simulating propagation over terrain. WSDBs implementing the DSA Model Rules must compute, for each WSD request, propagation from many TV stations and from the WSD to many pixels representing 'households'; based on conservative assumptions about the household TV receivers (notably the SINR), limits are computed to provide appropriate protection to each pixel, with the most stringent limit in each channel provided to the WSD. Nominet has operated a WSDB under this framework since January 2018.

Technical Difficulty for WSDB Administrators

Nominet agrees with Microsoft that there is no reason to continue holding any previously-valid concerns regarding the technical difficulty of operating a WSDB using terrain-based point-to-point propagation modelling. Large amounts of the computational task can be pre-generated and stored for fast retrieval, whether this be the signal propagation of each TV Station throughout its coverage, or (as with Ofcom) precomputed limits to protect all TV Stations at many possible WSD locations. Modern cloud computing techniques allow relatively-inexpensive computing power to be provisioned only when needed in response to demand, which was not the case when the current rules were first considered.

Nominet is ideally placed to assess the technical difficulties a WSDB administrator must face in implementing a WSDB using terrain-based point-to-point propagation modelling, taking into account any changes in the technical parameters of TV Stations as they occur. Indeed, Nominet already has solutions in place for each of these difficulties, and would be able to use these solutions to satisfy any future terrain-based TVWS protection framework with a relatively short lead-time.

Adjacent-channel Protection

Microsoft's proposal covers only changes to adjacent-channel TV protection, i.e. that co-channel TV protection will remain unchanged. Nominet is supportive in principle of using terrain-based point-to-point models for co-channel and adjacent-channel protection.

Nominet additionally recognizes that altering the co-channel rules would represent a fundamental change to the entire regulatory framework, with commensurate practical difficulties for all parties (particularly a lengthy period in which WSDBs must re-qualify); as such, Nominet supports Microsoft's proposal to consider changes to adjacent-channels rules and not to co-channel rules at this time.

Nominet welcomes the opportunity for WSDB administrators to differentiate themselves by providing greater adjacent-channel availability to WSDs under these proposals. Nominet would additionally have no objection to the proposed changes being mandatory.

There are a number of different approaches and details to be considered even within the ambit of a terrain-based adjacent-channel protection framework. While working in other jurisdictions, Nominet has developed a sophisticated set of tools for implementing, testing, and comparing protection rules for TVWS frameworks, and will consider in detail any future proposed rules.

3. Fixed WSDs at HAAT < 500m

Nominet believes it is feasible and not overly burdensome for a WSDB to provide a system to produce, on request, all broadcast contours within applicable separation distances of a WSD.

Nominet questions the necessity of Microsoft's proposal for a coordination process with nearby licensees, on the grounds that it is antithetical to the automated and light-touch unlicensed regime in which TVWS otherwise operates and benefits from, particularly taking into account

that channel availability for a WSD may change as a matter of routine. However, should such a process be deemed necessary by the Commission, Nominet proposes adding some further details:

- Prior to requesting broadcast contours, the installing party will notify a WSDB that it intends to commence the coordination process. The WSDB will provide a list of available channels and power limits at the WSD's location and height. The installing party will use this information to choose which channel(s) and transmit powers it will propose, and will register this information with the WSDB.

- Having requested broadcast contours and notified the relevant licensees, the installing party must notify a WSDB that each licensee has confirmed receipt of the notification. The 30-day trial period commences at this time, or 48 hours after the party initially notified the WSDB, whichever is the later.

- The progress of the WSD through the coordination process is part of its Fixed WSD Registration, and is published by, and synchronized between, WSDBs accordingly.

- During the 30-day trial period the WSD is required to contact a WSDB periodically to check its channel availability in the usual manner. Any WSD proposing to use more than one channel (e.g. channel-bonding) must use each of those channels during its trial operation.

- After the end of a 30-day trial period, the installing party must notify the WSDB that any interference complaints have been resolved and that it intends to begin regular operations, in some or all of the proposed channels and at a power not higher than its original proposal (i.e. allowing some mitigation measures to have been put in place during the trial).

- The installing party is given a grace period of 7 days after the end of the 30-day trial in which to give such a notification, during which the WSD may continue to operate as in the trial. This grace period also gives a reasonable amount of time to resolve any complaints which were submitted shortly before the end of the trial period.

- Alternatively, the installing party may notify the WSDB that it is abandoning its proposal, in the event that attempts to mitigate interference have failed.

- If channel availability changes, during or after the trial, in such a way as to preclude successful operation under its proposed channel(s) and power, then the installing party must notify the WSDB that it is abandoning the trial or operation, and must start the coordination process over again, choosing different channel(s) and power.

Nominet questions whether it is overly burdensome for the installing party to be required to notify all licensees regardless of the frequency separation with its intended channel(s).

To avoid the considerable burden of numerous manufacturers making changes to how their devices communicate with the WSDB, Nominet anticipate responding to requests from such WSDs for available channels by including only the proposed channel(s), with the power limit capped at the proposed power, whether during or after the trial. The coordination process is likely to be a implemented via a web portal, with the installing party manually entering the relevant details.

4. TVWS for Narrowband IoT

Microsoft's proposal to add clauses to §15.709(a) is effectively treating Narrowband WSDs as a distinct class of device from the existing three classes, namely Fixed, Mode I Personal/Portable, and Mode II Personal/Portable. Nominet supports this approach, but also notes there are implications of doing so that the Commission ought to consider.

Some IoT devices are likely to include integrated automated geolocation. Others, for reasons of cost-efficiency, will not include geolocation. Some may be fixed, others may be mounted on mobile platforms (e.g. drones). Some may be able to operate autonomously, whereas some may require a base-station. All these cases should be able to operate under suitable rules without risk of harmful interference to protected entities; indeed the rules for Fixed, Mode I, and Mode II Personal/Portable devices already take these various behaviours into account.[7]

The Commission should consider adding similar rules to describe which channels and power limits Fixed Geolocated Narrowband WSDs, Mobile Geolocated Narrowband WSDs, and Non-geolocated Narrowband WSDs are permitted to use, either for the initial connection to a base-station, or for ongoing transmissions.

5. Fixed WSD on Movable Platforms

Finally, Nominet also supports the Petition's recommendations on facilitating WSD in motion, for example in vehicles and industry. However, Nominet would welcome further clarity from the Commission on the rules for doing so.

Microsoft proposes that the WSD must check its location every 60 seconds to confirm that it is operating within its declared bounds. Nominet supports this approach, and notes that those bounds could cover the full extent of its journey, and could potentially be very large. Provided available channels and power limits are computed appropriately, this approach has no effect on the risk of interference compared to a fixed device.

Nominet notes though that rules requiring that a WSD to request channel availability at "multiple locations in [its] vicinity" is vague, does not address which set of locations would be sufficient for a given device with given planned movements, and does not address how the moving device must behave where channel availability differs between those locations. It additionally places on the WSD the burden of combining the channel availability across multiple locations; Nominet believes the WSDB is better equipped to do so. The same language is used both in Microsoft's proposal and the existing rules.[8] The Commission should consider further clarifying the rules in this regard.

Nominet proposes then that the WSD submits a bounding polygon to the WSDB as part of its request for spectrum. The WSDB will then compute a single set of available channels and power limits to cover the entire polygon, such that the available power (if any) in each channel is the minimum power available to any location within the polygon. For the purposes of calculating separation distances, the WSDB will treat the WSD location polygon in the same manner that it presently treats a WSD's point location (plus uncertainty), i.e. computing the minimum separation between the location polygon and the protected contour. If the WSD finds its location to be outside this bounding polygon, taking its location uncertainty into account, then it must immediately either contact the WSDB to request fresh channel availability, or cease transmission until it is again within its polygon.

Mobile WSDs operating in large areas, on long journeys, or in areas with patchy channel availability, may wish to divide its area of operation into multiple bounding polygons, requesting available channels for each to ensure continuity. All such sets of available channels are simultaneously valid, and the WSD can operate in the channels and powers available in

[7] Ibid. §15.711 (c)-(e)

whichever polygon it is located at any given moment. The WSD may submit bounding polygons which overlap somewhat, so as to give a necessary 'handover zone'.

Nominet appreciates the opportunity to respond in support of Microsoft's filing, and to offer our comments in this regard.

Respectfully submitted,

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